USGS
science for a changing world

Effects of West Nile Virus

USGS scientists are embarking on bold new research to better understand the consequences this disease may have on wildlife and human health

West Nile virus (WNV) has spread rapidly across North America, affecting thousands of birds, horses, and people since it was discovered in the Western Hemisphere. Since 1999, WNV has swept from the New York City region to almost all of the continental U.S., 7 Canadian provinces, and throughout Mexico and parts of the Caribbean.

The U.S. Geological Survey (USGS) is committed to understanding the effects of WNV. To do that and better answer the remaining questions surrounding the disease, USGS scientists are collaborating with many laboratories and agencies, including the Centers for Disease Control and Prevention (CDC), to learn more about the ecology of WNV, as well as embarking on bold research initiatives to investigate its future effects.

What is West Nile Virus?

West Nile virus first appeared in the Western hemisphere in 1999 and quickly spread through North America. It can infect at least 48 species of mosquitoes, over 250 species of birds, and at least 18 species of mammals, including humans. The virus is a member of the Flavivirus family, and is transmitted through infected mosquitoes.

USGS and Public Health

Wildlife disease scientists at the National Wildlife Health Center (NWHC; Center), the CDC, and other federal and state public health and wildlife agencies in the national WNV surveillance program, are monitoring birds for the presence of the virus. In addition, the NWHC is working with federal and state wildlife officials in investigating local and regional wildlife die-offs potentially due to WNV. Surveillence studies, die-off investigations, and experimental studies in the Center's biosafety level-3 (BSL-3) laboratories have allowed scientists to explore, and subsequently understand, not only the public health importance of the virus' arrival in the Western Hemisphere, but also its potential effect in wild bird populations.

USGS geographers are contributing to the national WNV surveillance effort by mapping WNV cases as they are reported to the CDC. This has allowed the CDC and the general public to monitor the virus' geographic movement, as well as seasonal trends and clusters of cases throughout the continental U.S. In addition, USGS and the CDC are investigating the ecology of potential WNV vectors and reservoirs in Louisiana. Using remote sensing and geographic information systems to map habitats and environmental factors, USGS and CDC are seeking to develop better models for understanding the associations between reservoir hosts, mosquitoes, environmental and climate conditions, and the virus itself.

When West Nile virus was first detected in New York, local governments began increasing insecticide use. USGS quickly recognized the need to develop highly sensitive tests and analyses to monitor these insecticides. This information is vital to land managers and vector-control agencies to ensure that insecticides are safe and effective. On Long Island, USGS is testing area waters for several insecticides, including resmithrin, sumithrin, malathion, and methoprene. USGS also monitors for a byproduct of methoprene and for the chemical piperonyl butoxide, which is used to enhance the effectiveness of some of the insecticides. These data help officials manage insecticide applications and help

Faces of Science: Emi Saito, WNV Coordinator

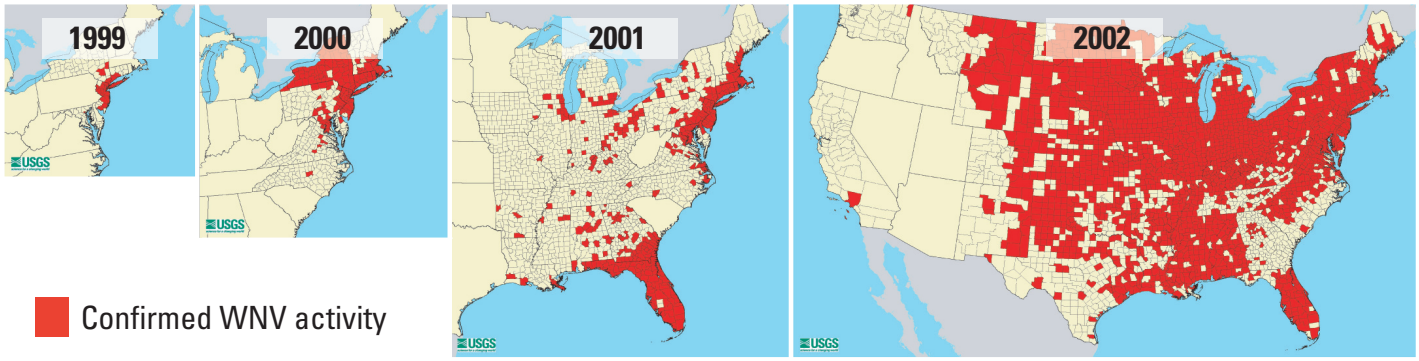
"In the five years since WNV has been discovered in North America, we've learned a lot about this disease and its effects on wildlife. We know that it's maintained in a bird-mosquito life cycle, we know many species are affected. But there are a lot of things we don't know. Which birds serve as important reservoirs? Which mosquito species can transmit the virus? How has the virus spread so quickly? Are mosquitoes the only mechanism in which the virus can over-winter? Are mosquitoes the sole significant mode of transmission to birds, humans, and horses? Will the geographic extent of the virus continue to expand, and if so, what effects will it have on new ecosystems? These are important questions that we still need to answer."

U.S. Department of the Interior
U.S. Geological Survey

Printed on recycled paper

FS 2004-3002
August 2003

West Nile Virus: Activity Over Time in North America



answer broader questions needed for environmental risk assessment of how these insecticides move through our environment.

USGS is also studying the role migrating birds play in disseminating West Nile virus. Investigators have captured and sampled more than 12,000 birds over the past 3 years at 8 different study locations along the east coast and 5 study locations along the Mississippi River. Based on the detection of WNV specific antibodies in these birds, scientists are seeing an increasing number of birds that were exposed to and have survived infections with WNV. Scientists have also detected WNV infections in 19 birds, primarily along the east coast in fall of 2003. While this represents very few of the birds sampled, all these birds were sampled at a critical time of daily southward migration. If these birds remained healthy and migrated southward shortly after sampling, they could have transported WNV along the migration corridor. More analysis is needed to understand the implications of these findings.

USGS New Research

Much work has been done to understand the public health effects of this disease since its arrival in New York City. However, the effect of WNV on wildlife populations, particularly wild birds, a major reservoir of the virus, is less understood. The NWHC is working on three new ambitious research studies to investigate WNV in wild birds.


Crows socialize in an NWHC BSL-3 laboratory

The first involves the Hawaiian Amakihi. Amakihi are part of a family of birds known as Hawaiian Honeycreepers, a diverse and successful avian species before the arrival of humans on the islands exposed them to invasive species and diseases. Today, at least 12 different species of Honeycreeper are endangered. The Center's Amakihi study will help assess the potential effect WNV could have on Hawaiian birds. Scientists are testing the birds' susceptibility to WNV infection, while investigating how well the virus is transmitted naturally via mosquitoes.

A second WNV study, done in close partnership with the USGS Fort Collins Science Center, investigates the effects of the disease on kestrels, a raptor prominent along the Front Range of Colorado. While nationwide monitoring of crows and blue jays continues, raptors and other passerine species have yet to be adequately studied. Scientists are monitoring the kestrels by taking tissue samples from adults, nestling, and fledgling birds over the course of between 12 and 30 months. The results of this study will help scientists understand the effects WNV is having on kestrel populations.

The third study looks at five non-native and one native Hawaiian bird species to determine their susceptibility to the virus, as well as testing the natural transmissibility of the virus. Of particular interest is the native golden plover, which occasionally migrates to Hawaii from the continental U.S, and could potentially spread WNV to the islands. We will also study the Japanese white-eye because it shares habitat with many native Hawaiian forest birds as well as Java sparrows, Laceneck and Zebra doves, and Mynah birds. This study will help scientists further understand the impacts of WNV, if it reaches Hawaii.


A USGS scientist draws blood from a sparrow

Other studies are planned to determine the susceptibility of indicator reptile, amphibian, and mammalian species to WNV, to monitor the changing genetic structure and virulence of the disease, and to determine the effects of WNV in pelican populations.

These studies, together with the collaborative programs and monitoring USGS is conducting with the CDC and other local public health and vector control agencies, paint a picture of a comprehensive research strategy to better understand WNV in wildlife and

For more information on West Nile virus projects, please contact Emi Saito, USGS, (608) 270-2456, Erik Hofmeister, USGS, (703) 648-4071, Stephen Terracciano, USGS, (631) 736-0783 x118, or Steve Guptill, USGS, (703) 648-4520.